

Amended claims filed on August 4, 2000

1. (Amended) A catalyst having activity under the irradiation of a visible light characterized in that said catalyst is titanium dioxide having stable oxygen defects and exhibits NO_x oxidation activity under the irradiation of a visible light at least in the wavelength region of from 400 to 600 nm.

2. (Deleted)

3. (Amended) The catalyst according to Claim 1, wherein said titanium dioxide is of anatase type or rutile type.

4. (Amended) The catalyst according to Claim 1 or 3, wherein the primary particle size of said titanium dioxide is 10 nm or less in diameter.

5. (Amended) The catalyst according to Claim 1, wherein the diffraction pattern of said titanium dioxide obtained by X-ray diffraction (XRD) is substantially free from patterns other than those assigned to anatase type titanium dioxide.

6. (Deleted)

7. (Amended) A catalyst having activity under the irradiation of a visible light characterized in that said catalyst is titanium dioxide having stable oxygen defects and the ratio of the peak area obtained by X-ray photoelectron spectroscopy assigned to the 1s electrons of oxygen participating in the bonds with titanium to that assigned to

the 2p electrons of titanium (O1s/Ti2p) is 1.99 or lower.

8. The catalyst according to Claim 7, wherein said area ratio (O1s/Ti2p) is in a range of from 1.5 to 1.95.

9. (Amended) The catalyst according to Claim 7 or 8, wherein said area ratio (O1s/Ti2p) remains substantially constant for time duration of 1 week or longer.

10. (Amended) A catalyst having activity under the irradiation of a visible light characterized in that said catalyst is titanium dioxide having stable oxygen defects and yields a signal having a g value of from 2.003 to 2.004 in the ESR measured in darkness at 77K under vacuum, provided that it yields a signal higher in intensity than the g value of from 2.003 to 2.004 above when measured at least under the irradiation of light in the wavelength region of from 420 to 600 nm at 77K in vacuum.

11. (Amended) The catalyst according to Claim 10, wherein a signal assigned to Ti^{3+} , which yields a g value of 1.96 when measured by ESR in darkness at 77K in vacuum, is substantially not observed on said catalyst.

12. (Amended) A catalyst having activity under the irradiation of a visible light, characterized in that said catalyst is an oxide semiconductor having stable oxygen defects and said oxide semiconductor is hafnium oxide, zirconium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, or a silicon oxide-titanium oxide based complex

oxide.

13. A method for producing a catalyst having activity under the irradiation of a visible light, which comprises treating an oxide semiconductor with hydrogen plasma, characterized by performing said treatment in a state substantially free from the intrusion of air into the treatment system.

14. A method for producing a catalyst having activity under the irradiation of a visible light, which comprises treating an oxide semiconductor with a plasma of rare gas element, characterized by performing said treatment in a state substantially free from the intrusion of air into the treatment system.

15. The method for producing a catalyst according to Claim 13 or 14, wherein said state substantially free from the intrusion of air into the treatment system is a state that the vacuum degree inside the tightly sealed system takes at least 10 minutes to make a change of 1 Torr.

16. A method for producing a catalyst having activity under the irradiation of a visible light, characterized by introducing ions of a rare gas element on at least a part of the surface of an oxide semiconductor by means of ion implantation.

17. (Amended) A method for producing a catalyst having stable oxygen defects and activity under the irradiation of a visible light characterized by comprising heating an oxide

semiconductor under vacuum.

18. The method for producing a catalyst according to any one of Claims 13 to 17, wherein said oxide semiconductor is titanium dioxide, zirconium oxide, hafnium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, or a silicon oxide-titanium oxide based complex oxide.

19. The method for producing a catalyst according to any one of Claims 13 to 17, wherein said oxide semiconductor is an anatase type titanium dioxide.

20. (Amended) A method for producing a catalyst having activity under the irradiation of a visible light, characterized by heating an anatase type titanium dioxide at a temperature of 400 °C or higher under a vacuum of 1 Torr or lower.

21. A catalyst having activity under the irradiation of a visible light, which was produced by a method according to any one of Claims 13 to 20.

22. The catalyst according to Claim 21, wherein said oxide semiconductor is titanium dioxide, zirconium oxide, hafnium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, or a silicon oxide-titanium oxide based complex oxide.

23. (Amended) The catalyst according to any one of Claims 1, 3-5, 7-12 and 21-22, wherein said activity under the irradiation of visible light is an oxidation activity or a reduction

activity.

24. (Amended) The catalyst according to any one of Claims 1, 3-5, 7-12 and 21-23, wherein said activity under the irradiation of visible light is a decomposition activity for inorganic and organic substances, or a bactericidal activity.

25. (Amended) The catalyst according to any one of Claims 1, 3-5, 7-12 and 21-23, wherein said catalyst is in a granular, a thin-film like, or a sheet-like shape.

26. (Amended) An article characterized in that the catalyst according to any one of Claims 1, 3-5 7-12 and 21-25 has been provided on the surface of a base material.

27. The article according to Claim 26, wherein said base material is an exterior wall of a building, an exterior plane of a roof or a ceiling, an outer plane or an inner plane of a window glass, an interior wall of a room, a floor or a ceiling, a blind, a curtain, a protective wall of highway roads, an inner wall inside a tunnel, an outer plane or a reflective plane of an illuminating light, an interior surface of a vehicle, or a plane of a mirror.

28. (amended) A method for photo decomposing a substance, comprising decomposing the object to be decomposed by bringing, under the irradiation of a light containing a visible radiation, a medium containing the object to be decomposed into contact with the catalyst according to any one of Claims 1, 3-5, 7-12 and 21-25, or with the article according to Claim 26 or 27.

29. The method according to Claim 28, wherein said object to be decomposed is at least one substance selected from the group consisting of inorganic compounds, organic compounds, microorganisms, and tumor cells.

30. The method according to Claim 28 or 29, wherein said medium is water or air.

31. The method according to any one of Claims 28 to 30, wherein said light containing a visible radiation is sunlight or an artificial light.

32. The method according to any one of Claims 28 to 31, wherein said artificial light is a light emitted from a fluorescent lamp, an incandescent lamp, and/or a halogen lamp.

33. (Amended) A photodecomposition device comprising a photocatalyst unit having the catalyst according to any one of Claims 1, 3-5, 7-12 and 19-25 provided on the surface of a base material, and a light source for irradiating a light including visible radiation to said photocatalyst.

34. The device according to Claim 33, wherein said light source for irradiating a light containing a visible radiation is a fluorescent lamp, an incandescent lamp, and/or a halogen lamp.

35. (Amended) An electrode for solar cell, which utilizes a material comprising the catalyst according to any one of Claims 1, 3-5, 7-12 and 19-25.

36. (Amended) An electrode for use in the photodecomposition

of water, which utilizes a material comprising the catalyst according to any one of Claims 1, 3-5, 7-12 and 19-25.

37. (Added) The catalyst according to any one of Claims 7-11, wherein said titanium dioxide is of anatase type or rutile type.

38. (Added) The catalyst according to any one of Claims 7-11, wherein the primary particle size of said titanium dioxide is 10 nm or less in diameter. *W*

39. (Added) The catalyst according to any one of Claims 7-11, wherein the diffraction pattern of said titanium dioxide obtained by X-ray diffraction (XRD) is substantially free from patterns other than those assigned to anatase type titanium dioxide.

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